CLAIMS

1. Breathing assistance apparatus capable of operating in alternating inhalation and expiratory phases and comprising:

- a pressurised respiratory gas source,
- control means capable of transmitting a reference value of a gas related parameter to the said gas source,
- an inhalation duct to supply the gas from the gas source to a patient,
- an expiratory duct for the expiratory gas of the patient,
- a valve on the inhalation duct, the said valve comprising means that allow the gas to pass to make possible proportional operation, the said valve being controlled by means which are distinct from the pressurised gas source,
- a valve on the expiratory gas source to help establish a PEP,
- sensors, respectively pressure (111) and flow (112), on the inhalation duct.

the apparatus being characterised in that:

- the said control means comprise selection means (152) capable of selecting a pressure parameter or a flow rate parameter to define the said reference value for the gas source
- the said selection means are controlled by an automatic control unit (51), the said control unit being:
  - connected to the pressure and flow rate sensors situated on the inhalation duct to form a direct closed regulation circuit for selecting a reference value parameter,
  - associated to a programme allowing the selection to be made in real time from a pressure or flow rate signal.
- so that the association of a direct closed regulation loop for the selection of a reference value parameter with a valve permitting proportional operation, allows real time control of barometric and

volumetric operating modes of the apparatus, between the inhalation and expiratory phases and during these phases.

2. Apparatus according to the previous claim characterised in that during the expiratory phases of the apparatus, the inhalation valve is capable of generating on its own a leak rate to compensate the leaks, so that no leak connection is associated to the inhalation valve.

3. Apparatus according to any of the previous claims, characterised in that the pressurised gas source is a centrifugal fan type turbine with an axial air intake and peripheral output, with an inertia value less than around 150 gcm^2.

4. Apparatus according to any of the previous claims, characterised in that:

- a second flow sensor is associated to the expiratory duct, and
- the said flow rate sensors of the inhalation and expiratory ducts are connected to comparison means to compare the respective flow rates in the inhalation and expiratory ducts.

5. Apparatus according to the previous claim, characterised in that the said comparison means are associated to processing means capable of filtering the difference between the said respective flow rates in real time.

6. Apparatus according to the previous claim, characterised in that the said processing means are connected to the said control unit, and these processing means are connected to a memory and a processor programmed to trigger a new inhalation phase when the said filtered difference is higher than a determined threshold

7. Apparatus according to any of the previous claims, characterised in that the inhalation valve comprises:

- a valve body comprising an orifice connected to the inhalation duct, and,
- a moving element capable of blocking the said orifice in a closed position, and at least partially free this orifice in the open position, the said moving element featuring a recess that can be aligned with the said orifice of the valve body to allow the gas from the gas source to pass through to the inhalation duct, the said recess comprising:
  - ➢ a first part, whose geometry corresponds to a proportional operation of the inhalation valve when the said first part is aligned with the said orifice,
  - ➢ a second part, whose geometry corresponds to an all or nothing operation of the inhalation valve when the said second part is aligned with the said orifice.

8. Apparatus according to the previous claim, characterised in that the said recess is shaped so that when the said moving element moves to move the inhalation valve from its closed position to its open position, the said first part is first of all aligned with the recess, then the said second part is then aligned with the said recess, if this movement continues.

9. Apparatus according to the previous claim, characterised in that:

- the recess comprises:
  - ➢ said first part of the recess is more or less triangular,
  - ➢ the said second part of the recess is more or less rectangular.
- a base of the triangle of the first part of the recess is parallel with one side of the rectangle of the second part of the recess.

10. Apparatus according to any of the previous claims, characterised in that to control the PEP, the expiratory valve is controlled by a micro-turbine.

11. Apparatus according to the previous claim, characterised in that the micro-turbine is directly connected to the expiratory valve, no intermediate element is positioned between the micro-turbine and the expiratory valve.

12. Operating control process of a apparatus of any of the previous claims, characterised in that to establish a PEP during the expiratory phases, the closure of the expiratory valve is controlled by a micro-turbine.

13. Process according to the previous claim, characterised in that when the apparatus operates, the micro-turbine operates constantly and the valve is controlled by the selective connection of a pneumatic control line of the said valve with the micro-turbine.

14. Process for operating an apparatus according to any of claims 1 to 11 in a volumetric mode, characterised in that when a volumetric mode is selected the control of the volume delivered to a patient is obtained by the control of the gas source on the basis of a measured pressure parameter on the inhalation duct.

15. Process according to the previous claim, characterised in that no pressure difference between an upstream part and a downstream part of the inhalation valve is used.

16. Process according to one of the two the previous claims, characterised in that said control of the gas source is obtained through the control of the rotation speed of a rotor of said gas source.